

# **BWROG LOOP-LOCA**

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Chairman BWROG RIR Option 3 Committee  
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# LOCA/LOOP Option

- Drop the requirement that LOOP be postulated in larger, more unlikely design-basis LOCAs
- Consider LOOP for all other LOCAs
- Delayed LOOP evaluated as not needed under a risk-informed approach

# Potential Safety Benefits

- Focus Industry and NRC on Risk-Significant SSCs
- Improved diesel generator reliability
  - slower start times
  - load sequencing based on more risk-significant scenarios
  - less challenging load sequencing
  - less challenging testing
- Improved ECCS equipment reliability
  - slower valve stroke times

# Potential Burden Reduction

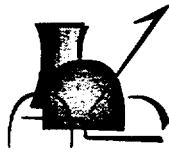
- Margin gain to LBLOCA ECCS criteria
  - peaking factors
  - power uprate
  - Relaxation in ESF equipment assumptions  
(e.g. valve stroke actuation times, pump flows)
- Relaxation in DG start times
- Relaxation in DG redundancy
- Relaxation in TS allowed outage times & surveillances for DGs, ECCS and other electrical equipment

# Needed Technical Analysis

- LOCA frequencies
  - Factor in IGSCC mitigation
- Conditional LOOP probabilities
- Consequences of delayed LOOP
  - For break sizes not excluded
- Review risk implications of plant changes

# Potential BWR Design Basis Changes

- LBLOCA (off-site power now available)
  - eliminate simultaneous LOOP
  - immediate ECCS pump start
- SBLOCA (assumes LOOP but relies on steam driven or diesel driven pumps)
  - DG start delayed
  - must evaluate delayed LOOP impact



## **Discussion of LOOP Frequency and Degraded Grid Data**

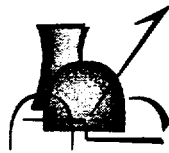
**FRANK J. RAHN  
JOHN GAERTNER**

**EPRI**

**Potential Changes to 10CFR 50.46 Meeting  
NRC White Flint North  
November 29, 2001**

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## **Comparison of EPRI LOOP/LOCA Results with SECY 01-133**

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## NUREG/CR-6538 Update

- NUREG/CR-6538 recognizes that in US LWR operating history, no LOCAs followed by immediate LOOP have occurred
  - TRIP-LOOP and ECCS ACTUATION-LOOP events are used as surrogates for LOCA-LOOP events
- Reviewed LERs for period 1984-93
  - Have extended the analysis 1994-2001
  - Coordinated review with NRC/BNL
- EPRI agrees that 6 LERs describe trips or ECCS actuations followed by 'LOOP' in 1984-93 period and preliminarily assigns 3 events in the 1994-2001 period

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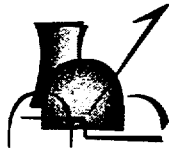
## LOOP Definition

- A LOOP occurs when offsite power is lost to the emergency safety buses such that they cannot provide the power needed to respond to a design basis accident in the FSAR
  - Partial losses of offsite power are not counted
  - For the purposes of this study, power interruptions to the ESF of 10 seconds or more are counted

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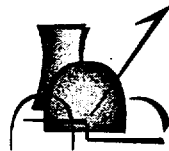


## EPRI's interpretation of LERs analyzed in NUREG/CR-6538

- 1986 ROBINSON 2 event was a LOOP
- 5 other events involved complicated sequences where availability of offsite power was briefly lost
- In 6 other events power remained available at all times as required by FSAR / DBA analysis
  - EPRI does not characterize these events as LOOPS

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## EPRI's interpretation of LERs in 1994-2000 Period

- There were 3 new events we recognize as surrogate LOOP/LOCA events
  - Oyster Creek 08/01/97
  - Nine Mile Point 2 06/24/99
  - Indian Point 2 08/31/99
- There are 2 events that are currently unresolved
  - These are very probably not surrogate LOCA/LOOP events, but require further confirmation
  - There are possibly a few more events, analysis is not complete
- In this period, there were 1323 scrams, giving a conditional probability of LOOP given a LOCA of about  $3E-3$

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## EPRI's interpretation of LERs in 1984-2000 Period

- There were 6 events we recognize as LOOP following a LOCA surrogate (trip/ECCS actuation) in original NUREG report and there are 3 events in current analysis, for a total of 9
- In this period, there were 3517 scrams, also giving a conditional probability of LOOP given a LOCA of about  $3\text{E-}3$

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## Summary of EPRI results for probability of LOOP given a LOCA

- 1984 - 1993  
 $6 \text{ events} / 2735 \text{ events} = 2 \text{ E-}3$
- 1991 - 2000  
 $3 \text{ events} / 1323 \text{ events} = \text{about } 3 \text{ E-}3$
- Total period 1984 - 2001  
 $9 \text{ events} / 3517 \text{ events} = \text{about } 3 \text{ E-}3$

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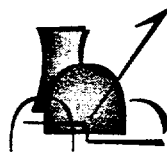


## **INDUSTRY EFFORTS TO PREVENT DEGRADED GRID CONDITIONS**

### **Perspective**

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## **Industry and NRC Concerns**

- **Heightened awareness over potential transmission voltage instability and offsite power supplies due to:**
  - Increased power transfers between regions
  - Lack of transmission capacity due to load growth
  - Lower active and reactive power margin due to low growth of generating capacity
  - Deregulation and separation of transmission and generating functions

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## Recent Industry Steps Taken to Address Concerns

- **INPO SOER 99-1**
- **Transmission Control Agreements**
  - Impact of potential & subsequent loss of large generator
- **Equipment upgrades and procedural changes to increase operating flexibility**
  - Operational impact and measures to monitor for and address double sequencing, fast transfer problems, and voltage margin for starting large loads

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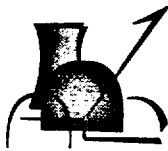


## INPO SOER 99-1

- **INPO Issued SOER 99-1 to ensure:**
  - communications with grid operators are robust
  - operators know how to respond to grid disturbances
  - design assumptions and trip set points are valid
  - plant switchyard equipment is adequately maintained
- **Industry Response**
  - Revised procedures (e.g., surveillance, instrumentation inaccuracy, communication with transmission providers)
  - Upgraded system studies (e.g., dynamic studies, generator reactive capability, energy management systems, etc.)
  - Plant upgrades (e.g., load tap transformers, additional capacitor banks, FACTS devices, etc.)

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## **SOER 99-01 Recommendation Status**

- Industry reviews of 51 stations to date indicate a high level of compliance with the SOER
  - Deficiencies being addressed
  - Industry will continue to assess implementation and monitor issue
- High licensee executive awareness and involvement in satisfactory implementation

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## **Status of Transmission Provider Agreements at BWR Plants**

- All BWR plants have formal agreements, either in place or under negotiation, with their Transmission Provider covering :
  - Notification / communications
  - Voltage maintenance
  - System maintenance
- In last 2 years, EPRI is aware of only 2 instances where the TP has notified the plant that it was unable to (briefly) meet contractual conditions

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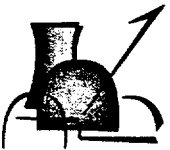


## Grid Reliability Standards

- NERC developing reliability standards affecting all portions of bulk electric system
- Reliability standards will be mandatory with full compliance enforced through monetary penalties
- Verification and periodic testing required of all generating companies, including:
  - Generator gross and net dependable capability
  - Reactive voltage capability
  - Voltage regulator controls
  - etc.

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## EPRI Grid Program

**Charter:** Identify, evaluate and develop the technologies and actions need to prevent and/or minimize disruption to the nation's electricity service

- Grid Security
- Distribution and disaster planning
- Communications
- Generation
- Markets / policy / risk assessment
- Complements
  - EPRI Power Delivery Initiative
  - DOD/EPRI Complex Interactive Network/Systems (CIN/S) Program
  - DOE/EPRI NEPO program

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## Conclusions

- EPRI analysis of the data referenced in SECY 01-133 and updated for the period 1994 – 2000 results in P(LOOP given a LOCA) of approximately  $3E-3$
- Recent experience with degraded transmission grid environment suggest that INPO recommendations and ISO/RTO protocols to protect nuclear units are working (both for voltage support and LOOP)
- Industry is taking pro-active steps to improve the reliability of the transmission grid

